



Measuring Fuel Contamination Using High Speed GC and Cone Penetration Techniques



Developer: Applied Research Associates
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Crosscutting Area: CMST

Subsurface
Contaminants
FOCUS AREA

Problem:

Decision processes during characterization and cleanup of hazardous waste sites are greatly retarded by the turnaround time and expense incurred through the use of conventional sampling and laboratory analyses. Furthermore, conventional soil and groundwater sampling procedures provide many opportunities for loss of volatile organic compounds (VOC) by exposing sample media to the atmosphere while transferring samples between and among sampling devices and containers. Although on-site analysis by conventional gas chromatography (GC) reduces turnaround time, it still often requires time consuming sample preparation and can not compensate for the pitfalls of conventional sampling procedures.

Solution:

A high speed GC and Cone Penetration Testing (CPT) system is being developed which can detect and measure subsurface fuel contamination at DOE sites in situ during the cone penetration process.

The system is portable and can conduct measurements in the unsaturated and saturated zones. Two modes of operation are supported; a continuous screening mode and an advanced analysis mode which will provide precision to the parts per billion (ppb) level.

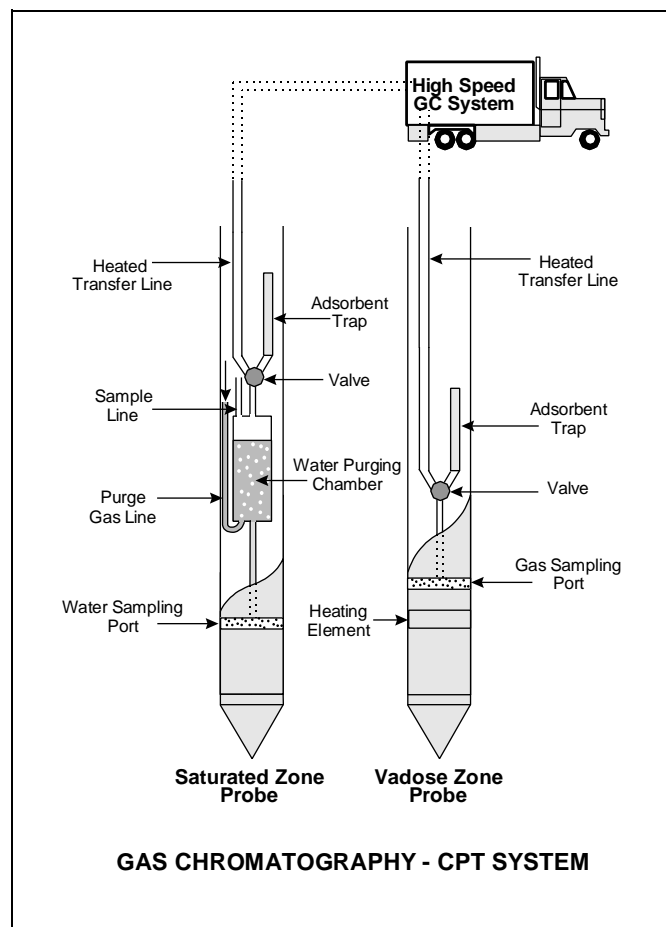
Benefits:

► Virtually continuous in situ quantification of fuel contamination is achieved in near real-time, supporting faster decision making and lowering expenses during characterization and cleanup.

► Sample concentrations are enhanced by in situ thermal extraction from the soil matrix to provide greater analytical precision.

► Loss of volatiles is minimized by eliminating sample exposure to the atmosphere and production is not constantly interrupted to retrieve sample media for laboratory analysis.

► No drilling spoils or wastes requiring costly disposal are generated, thus



also reducing the potential for worker exposure to contamination.

Technology:

The system consists of a heating and sampling CPT probe for use above the water table and a groundwater sampling and purging probe with optional down-hole traps for use below the water table. Purged samples can be transferred to the surface for High Speed GC analysis or retained on the down-hole traps for future laboratory verification. Each sampling probe is coupled via a heated sample transfer line to an uphole high speed GC located on the CPT rig.

The unsaturated zone vapor sampler heats the soil matrix ahead of the sampling screen to increase the proportion of VOC in the vapor phase, thereby shortening the time required to collect an adequate mass of contaminant for analysis. By elevating the temperature of the matrix, the equilibrium partitioning distribution changes, tending toward greater-vapor phase concentration and lower solid-phase (adsorbed) and liquid-phase (dissolved) concentrations.

The high speed GC uses direct vapor phase sample introduction

and flame ionization detection. Proprietary inlet-focusing technology allows collection of a large sample volume but limits the time over which the sample is introduced to the column to a duration of three to five milliseconds. The shortened introduction window and separation optimization techniques facilitate clean separations over a compact column length. Screening mode analyses for BTEX compounds can be performed typically in 25 seconds, or about every 25 centimeters of probe advancement. In the advanced analysis mode, concentrations can be detected in the ppb range within a one to three minute analysis time.

Field testing of the integrated system took place in July 1996 at a Vermont Agency Transportation.

Contacts:

Applied Research Associates, is a leading developer and manufacturer of CPT systems and instrumented probes for geotechnical and environmental subsurface investigations. For information on this project, the contractor contact is:

Principal Investigator:
Stephen P. Farrington
Applied Research Associates
Box 120-A Waterman Road
South Royalton, VT 05068
Phone: (802) 763-8348
Fax: (802) 763-8283
E-mail: sfarring@ara.com

DOE's Morgantown Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

DOE Project Manager:
P. Steven Cooke
Morgantown Energy Technology Center
3610 Collins Ferry Road
Morgantown, WV 26507-8880
Phone: (304) 285-5437
Fax: (304) 285-4403
E-mail: pcooke@metc.doe.gov

